



# Aligning science standards: Arkansas and the 2009 National Assessment of Educational Progress (NAEP)



Institute of Education Sciences

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July 2007

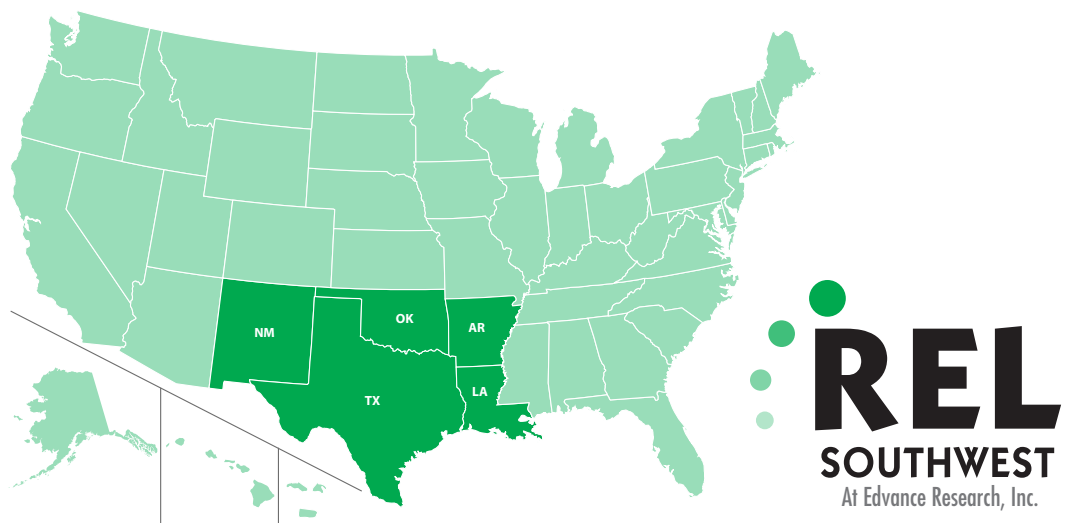
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## Summary

# Aligning science standards: Arkansas and the 2009 National Assessment of Educational Progress (NAEP)

**This policy research document is intended for Arkansas policymakers to use when examining possible changes to the Arkansas state assessment’s alignment with the National Assessment of Educational Progress (NAEP). The 2009 NAEP test is not yet in existence, so the purpose of this report is to give policymakers a headstart in determining where they might, if they so decide, begin to make changes in their assessment standards and create test specifications to develop an assessment system more closely aligned with that used for the NAEP.**

This report reveals alignment issues between the state’s tests and future NAEP tests and may be especially important to those considering revising their science standards and assessments in line with No Child Left Behind requirements for state science tests in elementary, middle, and high schools. Revising assessments requires considerable time and resources, so policymakers must carefully consider their capacity for making changes and the degree to which such changes will benefit students.

The analysis here uses the Arkansas Science Curriculum Frameworks for grades K–8 and for biology. The NAEP is administered to students in grades 4, 8, and 12, but Arkansas

conducts statewide tests in grade 5, grade 7, and biology. Since the Arkansas standards for grade 5, grade 7, and biology were most likely to appear on state assessments, they were used to compare Arkansas standards with the NAEP standards.

This study was designed to compare the NAEP and a corresponding state assessment framework. However, science specialists in Arkansas indicated that their statewide exams draw from the entire set of standards within the Science Curriculum Frameworks and thus this alignment was performed with the NAEP, which is an “assessment framework,” and the Arkansas Science Curriculum Frameworks, which are designed to indicate what science should be taught at various grade levels.

### Grade 4 alignment

Nearly all NAEP grade 4 content items are to some degree addressed by the Arkansas science framework, but the Arkansas statements typically are only partially aligned with NAEP statements and often are not found at the Arkansas grade 5 level. Most of the Arkansas grade 5 learning expectations go beyond the content covered by the NAEP. But most NAEP content is partially aligned with Arkansas content at grade levels above and below fifth grade. The overall alignment rating for NAEP

grade 4 standards and grade 5 Arkansas standards was 2.0—partial alignment. (A rating of 1 indicates no alignment, and a rating of 3, full alignment.)

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#### Grade 8 alignment

The majority of NAEP grade 8 content statements are partially aligned with the content found within the Arkansas Science Curriculum Framework. Most statements were given ratings of 2 because NAEP standards typically contain more detail than the corresponding Arkansas standards. More than half of Arkansas grade 7 science standards in the curriculum framework are unaddressed by the NAEP, most likely because the alignment was performed between the NAEP's more specific content areas—designed for use on an assessment—and Arkansas's more wide-ranging content areas—from its curriculum framework. The overall alignment rating when comparing the Arkansas Science Curriculum Framework to NAEP's grade 8 content statements was 2.1—partial alignment.

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#### Grade 12 alignment

Arkansas biology learning expectations are moderately aligned with NAEP's life science standards—all NAEP statements are at least partially addressed by Arkansas standards. Arkansas statements mostly imply the content explicitly stated by the NAEP. The overall alignment rating for NAEP life science was 2.1.

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#### Test specifications

Standards and test specifications are the starting point for developing tests and test items. In the ideal alignment study state science assessments would be directly compared with NAEP assessments at the item level. The NAEP 2009 assessment items may someday be available for such a study. Since the purpose of this report is to allow policymakers to examine their alignment with NAEP before the test is implemented, no further research is suggested.

**July 2007**

## TABLE OF CONTENTS

<b>Summary</b>	<b>iii</b>
<b>Background to the study</b>	<b>1</b>
<b>Content alignment at grade 4</b>	<b>3</b>
Areas of full alignment	4
Areas of partial alignment	4
Areas of nonalignment	5
Areas where Arkansas benchmarks go beyond the NAEP content statements	5
Summary of grade 4 alignment	5
<b>Content alignment at grade 8</b>	<b>6</b>
Areas of full alignment	6
Areas of partial alignment	7
Areas of nonalignment	7
Areas where Arkansas benchmarks go beyond the NAEP content statements	7
Summary of grade 8 alignment	7
<b>Content alignment at grade 12</b>	<b>8</b>
Areas of full alignment	9
Areas of partial alignment	9
Areas of nonalignment	9
Areas where Arkansas benchmarks go beyond the NAEP content statements	9
Summary of NAEP grade 12 alignment	10
<b>Appendix A The documents compared</b>	<b>11</b>
<b>Appendix B How the study was conducted</b>	<b>13</b>
<b>Appendix C Content alignment table for grade 4</b>	<b>18</b>
<b>Appendix D Content alignment for grade 8</b>	<b>30</b>
<b>Appendix E Content alignment for grade 12</b>	<b>41</b>
<b>References</b>	<b>53</b>
<b>Box 1 Methodology</b>	<b>3</b>
<b>Figures</b>	
<b>1</b> The majority of Arkansas grade 5 standards partially address the National Assessment of Educational Progress content statements	4
<b>2</b> The majority of Arkansas grade 8 standards partially address the National Assessment of Educational Progress content statements	6
<b>3</b> The majority of Arkansas biology standards partially address the National Assessment of Educational Progress life science content statements, but physical science and Earth and space science are not covered	8
<b>B1</b> Crosswalk instrument	16

## Tables

<b>1</b>	Average ratings of alignment of the Arkansas grade 5 Science Curriculum Framework and the National Assessment of Educational Progress grade 4 science content statements	4
<b>2</b>	Average ratings of alignment of the grade 7 Arkansas Science Curriculum Framework and the National Assessment of Educational Progress grade 8 science content statements	6
<b>3</b>	Average ratings of alignment of the Arkansas biology Science Curriculum Framework and the National Assessment of Educational Progress grade 12 science content statements	8
<b>A1</b>	National Assessment of Educational Progress distribution of items and standards by content area and grade	11
<b>A2</b>	Distribution of science learning expectations by strand, grades 5 and 7	12
<b>A3</b>	Distribution of science learning expectations by strand, high school biology	12
<b>C1</b>	Alignment of National Assessment of Educational Progress grade 4 science and Arkansas grade 5 standards	18
<b>C2</b>	Arkansas grade 5 standards not covered by NAEP grade 4 content	29
<b>D1</b>	Alignment of National Assessment of Educational Progress grade 8 science and Arkansas grade 7 standards	30
<b>D2</b>	Arkansas grade 7 standards not covered by NAEP grade 8 content	40
<b>E1</b>	Alignment of National Assessment of Educational Progress grade 12 science and Arkansas biology standards	41
<b>E2</b>	Arkansas biology standards not covered by NAEP grade 12 content	52



**This policy research document is intended for policymakers to use when examining possible changes to the Arkansas state assessment's alignment with the National Assessment of Educational Progress (NAEP).**

## **BACKGROUND TO THE STUDY**

This report presents the findings of an alignment study comparing the new science framework for the 2009 NAEP and its accompanying Science Assessment and Item Specifications with the Arkansas state science assessment. More details about the documents compared are in appendix A. The study was conducted for the Regional Education Laboratory Southwest, funded by the Institute of Education Sciences, to provide research and support to Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. The study was undertaken in anticipation of a growing need in the region to

be better informed about how state assessment standards in science compare with those tested in the NAEP.

The 2009 NAEP test is not yet in existence, so the purpose of this report is to give policymakers a headstart in determining where they might, if they so decide, begin to make changes in their assessment standards and create test specifications to develop an assessment system more closely aligned with that used for the NAEP.

Five factors make this alignment study timely. First, the importance of state science assessments has been increased by the No Child Left Behind Act of 2001. Beginning in the 2007/08 school year, states are required to administer science assessments to all students in each of the elementary, middle, and high school levels, holding states and local school districts accountable for student academic achievement in science (NCLB, 2001).

Second, the NAEP is increasingly being used as a benchmark against which student achievement across the nation can be compared (Linn, 2005; Linn, Baker & Herman, 2005). The NAEP has been dubbed the “nation’s report card,” and when fresh NAEP results are released—as they were for science in 2006, following an administration of the test in 2005—the media report the results (Cavanagh, 2006a, 2006b). Although states are not sanctioned for failing to demonstrate NAEP student performance improvement, NAEP data do provide an external accountability benchmark and serve to verify student achievement on state assessments. In fact, the National Center for Education Statistics has a website (<http://nces.ed.gov/nationsreportcard/nde/state-comp/>) that allows anyone to create customized comparative reports based on the latest NAEP data. So anyone can create tables that compare states and jurisdictions based on the average scale scores for selected groups of public school students within a single assessment year, or compare the change in performance between two assessment years.

Third, NAEP data are being used more in education research to investigate how the No Child Left Behind Act provisions have played out in different states. For example, Olson (2005) compared the percentages of students at or above the proficient level on the 2005 state grade 8 mathematics assessments in 33 states. The study showed that, on average, 33 percent more students scored at the proficient level or above according to the state assessment than did so according to the NAEP. As yet, no similar study has been done of science, but with the release of the 2005 NAEP results it is now possible to do so.

Fourth, political attention is beginning to focus on using the NAEP as a yardstick for measuring state standards (Olson, 2007). In January 2007 two bills were introduced in Congress, one seeking to encourage states to benchmark their own standards and tests to NAEP and the other calling for states to adopt voluntary “American education content standards” in mathematics and science that would be developed by the National Assessment Governing Board, the body responsible for the NAEP. These issues will doubtless be a topic of debate in the upcoming reauthorization of the No Child Left Behind Act.

Fifth, the standards and test specifications that form the blueprint for the content the NAEP science assessment covers and the types of items it uses were revised. In 2006 the 2009 NAEP framework takes account of the latest knowledge on science learning and assessment, which suggests that measuring student understanding involves much more than assessing

factual knowledge. It defines the science knowledge and skills that science-literate students should possess at grades 4, 8, and 12. The assessment itself, while retaining some familiar paper and pencil assessment formats, will also include student performance assessments in both classroom settings and computer simulations. The 2009

NAEP framework will determine the shape of NAEP science assessments through 2017, setting the direction of science assessment across the nation.

These factors are working together to gradually raise the NAEP to a de facto national benchmark, and states naturally want to know how well their state standards align with the NAEP so they can make informed decisions about possible changes to their own standards and assessment systems. This report describes the results of a systematic alignment study conducted for that purpose. Details of the study are in appendix B.

The intent of this report is to inform those in the Arkansas Department of Education who are responsible for shaping the state assessment in science how the current assessment standards compare with those of the NAEP 2009 assessment.

Similar reports have been completed for Louisiana, New Mexico, Oklahoma, and Texas, but there is no intent to compare Arkansas with these states. The audience of this report is solely those in the Arkansas Department of Education who are interested in the state’s alignment with NAEP 2009 science standards. This report shows where there is good content alignment with NAEP standards, identifies where there is partial alignment, pinpoints NAEP standards where there are no corresponding state standards, and highlights where the Arkansas standards go beyond the NAEP. The reports on the other Southwest Region states also deal with the assessment specifications, showing what percentages of the NAEP assessment at each grade level are devoted to different science topics and comparing that to the coverage of the topics in the states’ assessments. However, this report differs in that it does not include an analysis of test specifications because they were not readily available and in that it uses the state’s curriculum standards because Arkansas state science specialists do not have a separate set of assessment standards as other states do.

**Several factors are working together to raise the National Assessment of Educational Progress to a de facto national benchmark, and states want to know how well their state standards align with it**

The results are presented in summary in the tables and narratives in the sections that follow. Those sections provide an analysis that highlights the differences found between the NAEP assessment and the Arkansas state assessment. For more detail about the alignment of the Arkansas curriculum standards to the individual content statements of the NAEP, turn to the tables in appendixes C–E. They show exactly which Arkansas standards align with a particular NAEP statement and, in cases of partial alignment, explain why. For a discussion of methodology, see box 1 and appendix B.

## CONTENT ALIGNMENT AT GRADE 4

The NAEP grade 4 science standards were compared with the Arkansas Science Curriculum Framework primarily at grade 5, which is when Arkansas gives its elementary science benchmark tests. Arkansas recommended using its Science Curriculum Framework for this study because all assessment content was drawn from standards within the curriculum framework. Thus, while the alignments performed with other states in the Southwest Region were completed using only the subset of curriculum content found within

### BOX 1

#### Methodology

The chief research question driving this study was “To what extent do current state assessment standards cover the content on which NAEP 2009 assessments will be based?” This question was addressed using curriculum standards instead of assessment standards because the Arkansas state science specialists indicated that all curriculum standards were used for test development and no subset of “assessment standards” was available. The studies for the other Southwest Region states address the question “To what extent do current state assessment specifications align with the NAEP 2009 assessment specifications?” but there were no science assessment specifications readily available for use in the study for Arkansas.

The methodology used to answer the chief research question followed the successful pattern of a similar study conducted by WestEd in New England, which examined the alignment of math and reading standards with the NAEP. The methodology

developed by WestEd for the New England study was designed to include all the most prominent alignment methodologies, discussed in appendix B. Thus far, alignment studies and methods have focused on aligning standards and tests, whereas the objective of this study was to compare one set of assessment standards and specifications with another. The methodology in this study, however, is based upon methodologies for aligning standards to tests, because similar principles are used in both types of alignments.

In this study reviewers followed the methodology of the portion of the previous study examining alignment between two sets of standards. Reviewers performed gap analyses to identify content included in one set of standards but not the other, identified issues of order so they could reveal differences in the grade levels at which standards appear, and examined the degree to which the standards and assessments cover content to the same depth and have similar cognitive demands (depth-of-knowledge) and the degree to which assessments cover the same

range of content as the corresponding standards (range-of-knowledge correspondence) to determine whether there was a match between Arkansas and NAEP in the level of detail, the cognitive demands, and the range of content covered. A coding scheme (similar to that of the Buros Center) was used to indicate alignment issues and reviewer ratings, and a matrix-like format (similar to Porter’s method) was created to facilitate alignment (see appendix B).

Reviewers attended several training sessions, conducted individual reviews, and then met in teams of two to reach consensus on ratings (similar to the Project 2061 method). This consensus method was designed to create one consensus rating per NAEP standard with the help of a moderator and was not intended to allow for disagreements. This methodology was determined to be best suited to the scope and timing of this study. The consensus methodology is designed to highlight areas for states to examine, not to gather large amounts of data, record multiple ratings, or measure interrater reliability (see appendix B for more on methodology).

TABLE 1

**Average ratings of alignment of the Arkansas grade 5 Science Curriculum Framework and the National Assessment of Educational Progress grade 4 science content statements**

NAEP content area (number of NAEP standards)	Average rating
Overall physical science (15)	2.0
Matter (6)	2.3
Energy (5)	2.0
Motion (4)	1.8
Overall life science (7)	2.0
Structures and functions of living systems (4)	2.3
Changes in living systems (3)	1.7
Overall Earth and space science (11)	2.0
Earth and space in time (3)	2.0
Earth structures (3)	1.7
Earth systems (5)	2.2
All content (33)	2.0

*Note:* Rating is based on a scale of 1 to 3, where 1 indicates that state standards do not address NAEP content statement, 2 that they partially address NAEP content statement, and 3 that they fully address or exceed NAEP content statement by targeted grade level.

assessment frameworks, Arkansas's alignment was performed with the complete set of its curriculum content.

For grade 4 the NAEP provides 33 distinct content statements (displayed in parentheses in table 1). Four (12 percent) of these content statements are fully addressed by Arkansas standards, 25 (76 percent) partially addressed, and 4 (12 percent) unaddressed (figure 1).

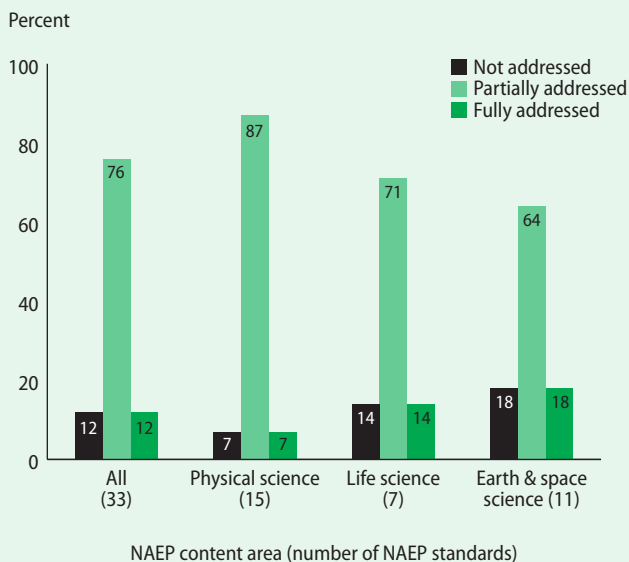
The average alignment rating for grade 4 is 2.0 (table 1). The majority of content statements were given ratings of 2, which means that state standards partially address the NAEP content statements (figure 1 and appendix C).

#### Areas of full alignment

Four NAEP grade 4 content statements are fully addressed by Arkansas student learning expectations. One of 15 physical science NAEP statements

FIGURE 1

**The majority of Arkansas grade 5 standards partially address the National Assessment of Educational Progress content statements**



has full alignment with Arkansas standards, as do 1 of 7 life science statements and 2 of 11 Earth and space science statements.

The four NAEP grade 4 content statements fully addressed by the Arkansas Science Curriculum Framework at grade 5 are P4.1—properties of objects and measuring mass and volume, L4.3—interdependence of organisms, including beneficial and detrimental interactions, E4.8—day to day and seasonal changes in weather, and E4.11—human dependence on and change of the environment.

#### Areas of partial alignment

Twenty-five (76 percent) of NAEP grade 4 content statements have partial alignment, in large part because many Arkansas benchmarks imply content explicitly stated by the NAEP and because the NAEP content was often found to be addressed by Arkansas at a higher grade level than fifth.

Raters found that many Arkansas benchmarks imply content that the NAEP addresses in depth. For example, Arkansas PS.7.2.3 states,

“Demonstrate methods of using electricity to produce light, heat, and sound,” while its corresponding NAEP statement P4.7 reads, “Heat (thermal energy), electricity, light and sound are forms of energy.” The Arkansas standard does not explicitly mention “forms of energy,” but it is implied. In Earth and space science Arkansas ESS.8.29, 8.3.10, and 8.4.11 correspond to NAEP E4.9, which contains content regarding scientists using tools for observing, recording, and predicting weather changes over days and over seasons. The Arkansas statements include content regarding various instruments used in collecting weather data, but imply the content regarding observing, recording, and predicting, as well as the content regarding seasons.

NAEP items are also often addressed in higher Arkansas grade levels. For example, in physical science NAEP’s P4.13, which covers objects in motion, was found to match to Arkansas learning expectations only in grade 6, while the elementary school benchmark test in Arkansas is given at grade 5. In addition, in life science NAEP L4.7, with content regarding advantageous survival characteristics of different organisms, was matched to one fourth grade standard that mentions environmental adaptations but also to sixth and eighth grade standards that mention natural selection and the increase in likelihood of survival. In Earth and space science NAEP E4.1 contains content regarding objects in the sky and their patterns of movement, including the changing of paths over the seasons. Arkansas has several learning expectations that match this content in the second and third grades, however, the concept of seasons is not mentioned until the seventh grade (ESS.10.7.5).

#### Areas of nonalignment

Four NAEP statements are unaddressed by Arkansas learning expectations. In physical science NAEP P4.12 covers relative observation and an object’s position. In life science L4.6 states “Plants and animals closely resemble their parents.” In Earth and space science E4.7 states, “The sun warms the

land, air, and water and helps plants grow” and E4.5 states, “Natural materials have different properties, which sustain plant and animal life.”

#### Areas where Arkansas benchmarks go beyond the NAEP content statements

Arkansas has 83 learning expectations in its grade 5 science framework. The NAEP does not address, in its content statements, the 9 Arkansas statements in nature of science, 24 of the 29 in life science, 15 of the 23 in physical science, and 22 of the 22 in Earth and space science. Eighty-four percent of Arkansas grade 5 standards go beyond NAEP content statements.

The NAEP does not address the nature of science statements because it discusses inquiry in a section separate from the content statements, called “science practices,” intended to crosscut all NAEP content.

The reviewers found that very few fifth grade Arkansas standards match well with the NAEP’s fourth grade content statements, which the abundance of “HG” and “LG” codes in table C1 in appendix C shows, because Arkansas conducts its elementary benchmark test at grade 5, so most of the Arkansas content that matched NAEP content was found in lower or higher grade levels in Arkansas.

#### Summary of grade 4 alignment

Nearly all NAEP content items are addressed to some degree by the Arkansas science framework, but the Arkansas statements are typically only partially aligned with NAEP statements, which often were not found at the grade 5 Arkansas level. The Arkansas grade 5 learning expectations mostly went beyond the content covered by the NAEP. However, most

**Nearly all NAEP content items are addressed to some degree by the Arkansas science framework, but the Arkansas statements are typically only partially aligned with NAEP statements**

TABLE 2

**Average ratings of alignment of the grade 7 Arkansas Science Curriculum Framework and the National Assessment of Educational Progress grade 8 science content statements**

NAEP content area (number of NAEP standards)	Average rating
Overall physical science (16)	1.9
Matter (7)	2.0
Energy (6)	1.7
Motion (3)	2.0
Overall life science (12)	2.2
Structures and functions of living systems (8)	2.3
Changes in living systems (4)	2.0
Overall Earth and space science (15)	2.3
Earth and space in time (4)	2.5
Earth structures (6)	2.2
Earth systems (5)	2.4
All content (43)	2.1

*Note:* Rating is based on a scale of 1 to 3, where 1 indicates that state standards do not address NAEP content statement, 2 that they partially address NAEP content statement, and 3 that they fully address or exceed NAEP content statement by targeted grade level.

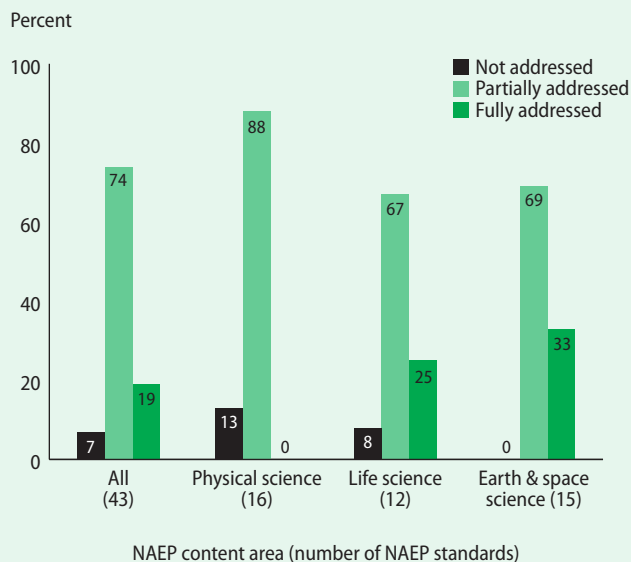
NAEP content was found to be partially aligned with Arkansas content at grade levels above and below fifth grade. The Arkansas content at various grade levels that corresponds to the NAEP content statements are typically partially aligned with NAEP content, as some NAEP content is implied but not explicitly stated in Arkansas standards and, or sufficiently aligned content could be found only at subsequent grade levels. The overall alignment rating is 2.0, which indicates partial alignment.

## CONTENT ALIGNMENT AT GRADE 8

NAEP grade 8 science standards were compared with the Arkansas Science Curriculum Framework, primarily at grade 7. Arkansas recommended using its Science Curriculum Framework for this study, as the state's assessment specialists stated that all assessment content was drawn from all standards within the curriculum framework. In addition, Arkansas grade 7 student learning expectations

FIGURE 2

**The majority of Arkansas grade 8 standards partially address the National Assessment of Educational Progress content statements**



were used because Arkansas conducts its statewide middle school exam in the seventh grade.

For grade 8 the NAEP provides 43 distinct content statements (displayed in parentheses in table 2). Eight (19 percent) are fully addressed by Arkansas standards, 32 (74 percent) partially addressed, and 3 (7 percent) unaddressed.

The alignment level between the Arkansas Science Curriculum Framework and the NAEP standards is 2.1, with the majority of NAEP content statements receiving an alignment rating of 2, which indicates partial alignment (figure 2 and appendix D).

### Areas of full alignment

Eight NAEP grade 8 content statements are fully addressed by Arkansas standards. Three of 12 life science statements have full alignment, as do 5 of 15 Earth and space science statements.

The eight NAEP grade 8 content statements fully addressed by the Arkansas Science Curriculum Framework were: L8.2—fertilization, cell division, and differentiation; L8.7—ecosystems' support



of organisms, biotic and abiotic factors; L8.9—reproduction; E8.3—fossils as evidence of change; E8.4—Earth processes; E8.10—Earth’s magnetic field; E8.12—seasons and their cause; and E8.13—global weather patterns.

### Areas of partial alignment

Thirty-two (74 percent) of NAEP grade 8 content statements have partial alignment. NAEP was often found to include more detail within many of its standards than did Arkansas.

Raters repeatedly found that many Arkansas standards do not have as much detail as NAEP’s statements; 80 percent of the 32 partially aligned NAEP statements were given a code for “more detail.” For example, NAEP P8.8 and P8.9 were matched to Arkansas PS.7.7.3, which states, “Conduct investigations to identify types of kinetic and potential energy.” However, the NAEP statements include examples of kinetic and potential energy, while Arkansas’s statements do not. Reviewers noted that Arkansas’s corresponding standard was much more general than the NAEP standard, which contains specific examples and that the state’s standard is performance-based while the NAEP standard is content-based. In life science several examples of NAEP statements containing more detail than Arkansas standards can be found. For example, NAEP L8.5 describes and defines producers, consumers, and decomposers, while Arkansas’s corresponding standard LS.4.5.142 includes the terms “producers, consumers, decomposers,” but does not define the terms as the NAEP does. Another example of this mismatch in detail can be found in Earth and space science, where NAEP E8.7 is matched with Arkansas ESS.8.7.1. While the Arkansas standard states, “Describe the composition and physical characteristics of the atmosphere,” the NAEP more specifically mentions the gases of which the atmosphere is composed and the differences at atmospheric levels.

### Areas of nonalignment

Three NAEP statements are unaddressed by the Arkansas Science Curriculum Framework’s

content statements—two in physical science and one in life science.

In NAEP physical science the unaddressed content statements are P8.11—light energy from the sun and P8.13—nuclear reactions in the sun, light energy from the sun and photosynthesis. In life science the unaddressed statement is L8.10—characteristics of organisms influenced by heredity and the environment.

### Areas where Arkansas benchmarks go beyond the NAEP content statements

Arkansas has 85 total student learning expectations listed in the Science Curriculum Framework for grade 7. NAEP does not address more than half of these standards, including the nine Nature of science standards, 17 of the 23 life science standards, 10 of the 21 physical science standards, and 19 of the 32 earth and space science standards.

The NAEP does not address Arkansas nature of science standards because it discusses content related to science inquiry in a section separate from the content statements, called “science practices,” intended to crosscut all NAEP content.

The 55 Arkansas grade 7 standards unaddressed by the NAEP are listed at the end of the content alignment table (table D1) for NAEP grade 8 in appendix D.

### Summary of grade 8 alignment

The majority of grade 8 content statements are partially aligned between the Arkansas Science Curriculum Framework and the NAEP. Most statements were given alignment ratings of 2 because NAEP content statements typically contain more detail than the corresponding Arkansas standards. More than half of Arkansas grade 7 standards in the Science Curriculum

**The majority of grade 8 content statements are partially aligned between the Arkansas Science Curriculum Framework and the NAEP**

Framework are unaddressed by the NAEP, most likely because this alignment was performed between the NAEP’s more specific content areas, designed specifically for use on an assessment, and Arkansas’s more wide-ranging areas of content contained within its entire curriculum framework. The overall alignment rating when comparing the Arkansas Science Curriculum Framework to the NAEP grade 8 content statements was 2.1, indicating partial alignment.

CONTENT ALIGNMENT AT GRADE 12

The primary purpose of this study is to compare the NAEP assessment content standards with the appropriately corresponding state assessment content standards. For Arkansas the most suitable document for comparison for grade 12 is the Arkansas biology curriculum framework because the only subject area in which Arkansas tests its high school students on a statewide basis is biology. Additionally, science specialists in Arkansas indicated that all content items within the curriculum framework are used in developing the statewide tests and that the Biology Curriculum Framework was the most suitable document for use in this study. Therefore, NAEP grade 12 science standards were compared only with the Arkansas biology Science Curriculum Framework.

For grade 12 the NAEP provides 49 distinct content statements (displayed in parentheses in table 3). One (2 percent) is fully addressed by Arkansas learning expectations within the biology curriculum framework, 12 (24 percent) are partially addressed, and 36 (73 percent) are unaddressed.

The average alignment rating for grade 12 is 1.3. The majority of content statements were given ratings of 1, which means that state standards do not address the NAEP content statement (figure 3 and appendix E).

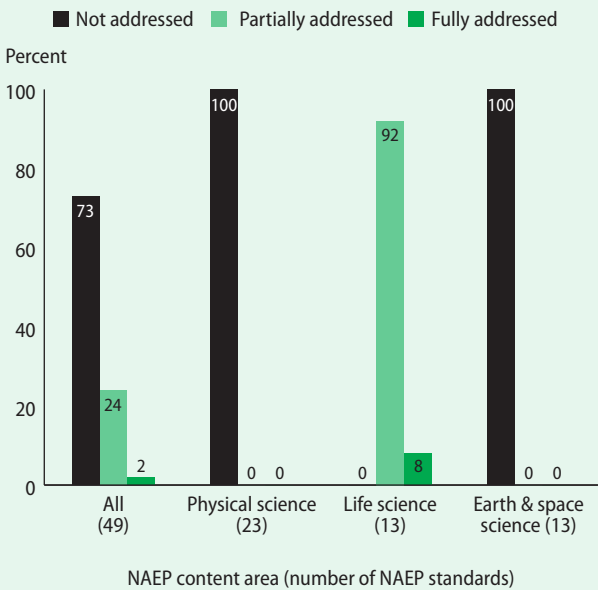
This review used only the Arkansas biology curriculum framework, which does not address

TABLE 3  
Average ratings of alignment of the Arkansas biology Science Curriculum Framework and the National Assessment of Educational Progress grade 12 science content statements

NAEP content area (number of NAEP standards)	Average rating
Overall physical science (23)	1.0
Matter (7)	1.0
Energy (9)	1.0
Motion (7)	1.0
Overall life science (13)	2.1
Structures and functions of living systems (7)	2.1
Changes in living systems (6)	2.0
Overall Earth and space science (13)	1.0
Earth and space in time (7)	1.0
Earth structures (1)	1.0
Earth systems (5)	1.0
All content (49)	1.3

Note: Rating is based on a scale of 1 to 3, where 1 indicates that state standards do not address NAEP content statement, 2 that they partially address NAEP content statement, and 3 that they fully address or exceed NAEP content statement by targeted grade level.

FIGURE 3  
The majority of Arkansas biology standards partially address the National Assessment of Educational Progress life science content statements, but physical science and Earth and space science are not covered





content in the NAEP areas of physical science and Earth and space science. Consequently, reviewers gave ratings of 1 to indicate no alignment within those two areas. For the life science portion of the NAEP, Arkansas biology content had an overall rating of 2.1, which indicates that the biology curriculum framework's content partially covers the life science content of the NAEP.

### Areas of full alignment

One NAEP grade 12 content statement is fully addressed by Arkansas high school biology curriculum standards. NAEP L12.1, which addresses the composition of complex molecules that make up living systems, is fully addressed by Arkansas MC.1.B.1, which asks students to describe the structure and function of the major organic molecules found in living systems.

### Areas of partial alignment

Twenty-four percent of NAEP grade 12 content statements have partial alignment with the Arkansas biology curriculum framework. Arkansas implies much of the content that NAEP explicitly states.

Arkansas's content statements often address the NAEP content implicitly, as 12 of the 13 life science content statements were given the implied content code. An example of implied content in life science is Arkansas learning expectation MC.1.B.2, which corresponds to NAEP L12.2. The NAEP's content includes details regarding the carrying out of cellular processes by different molecules, including proteins, as well as details regarding the composition and functioning of proteins. Arkansas MC.1.B.2 states only, "Describe the relationship between an enzyme and its substrate molecule(s)." Another example is the alignment between NAEP L12.4 and Arkansas MC.3.B.4. NAEP's content includes plants' conversion of light into high energy sugar molecules, which can be used to make amino acids and other organic molecules, while Arkansas's content includes the conversion of light energy to chemical energy by photosynthetic

organisms but does not specify the formation of sugar molecules that contain carbon, hydrogen and oxygen, as the NAEP does.

### Areas of nonalignment

All of physical science and Earth and space science standards were unaligned because this comparison was being performed only with the Arkansas biology curriculum framework. Within life science all the NAEP grade 12 content statements were at least partially addressed.

### Areas where Arkansas benchmarks go beyond the NAEP content statements

Arkansas has an extensive list of 97 learning expectations in the biology Science Curriculum Framework. The NAEP does not address 76 (78 percent) of them: 15 of the 20 molecules and cells statements, 8 of the 19 heredity and evolution statements, all 22 of the classification and diversity of life statements, 6 of the 11 ecology and behavioral relationships statements, and all 25 of the nature of science statements.

The NAEP does not address the nature of science statements because it discusses inquiry, technology, and various other concepts under nature of science in a section separate from the content statements, called "science practices," intended to crosscut all NAEP content.

Because this alignment was being performed between the NAEP physical, life, and Earth and space science standards and only Arkansas

biology standards, the NAEP did not address the vast majority of the items within the Arkansas biology curriculum framework. As a curriculum framework, the Arkansas document is intended to contain comprehensive coverage of biology. The NAEP, by contrast, is a test that covers physical science, life science, and Earth and space science and therefore does not extensively cover biology.

**The Arkansas biology learning expectations are moderately aligned with NAEP's life science**

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### Summary of NAEP grade 12 alignment

The Arkansas biology learning expectations are moderately aligned with NAEP's life science, as all NAEP statements are at least partially addressed by Arkansas standards. The Arkansas statements mostly implied the content explicitly stated by the NAEP. The overall alignment rating for NAEP life science was 2.1.

This study is intended to compare the NAEP assessment framework with state assessment frameworks. The most suitable assessment content for this study is in the Arkansas biology curriculum framework because the only subject area in which Arkansas tests its high school students on a state-wide basis is biology and the state does not have a separate and readily accessible assessment content document. Because this alignment was performed using only the Arkansas biology curriculum

framework, Arkansas is mostly unaligned with the NAEP, which includes content in physical and Earth and space sciences, and Arkansas's biology content was found to greatly exceed what is covered by the NAEP.

One reviewer found the framework easy to understand and the coding and organization easy to follow. However, another reviewer commented that topics appeared too much as lists instead of specifying what concepts students should understand and how they should be able to apply the concepts.

Because only Arkansas's biology content was reviewed for this study, the overall alignment between all NAEP content and Arkansas biology was 1.3, indicating an overall level of nonalignment. However, upon examining only the life science section of the NAEP, the alignment was 2.1, indicating partial alignment.